

# Identification of molecular mechanisms of stress-resistance in turkeys to improve meat quality

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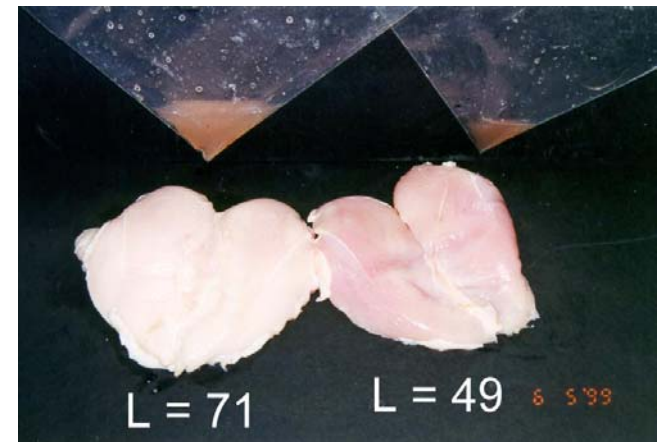
Michigan State University

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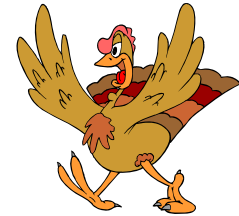
# *Pale, Soft, Exudative (PSE) Meat*

- A meat quality defect, originally observed in pork
- PSE meat characteristics:
  - Abnormally light color
  - Flaccid texture
  - Poor water holding capacity
- Higher frequency in growth-selected animals
- Higher frequency in summer season



# *Hypothetical Mechanism for the Development of PSE Turkey Meat*

**Birds encounter heat stress**



**Black box**



**Elevated muscle  $[Ca^{2+}]_{res}$**

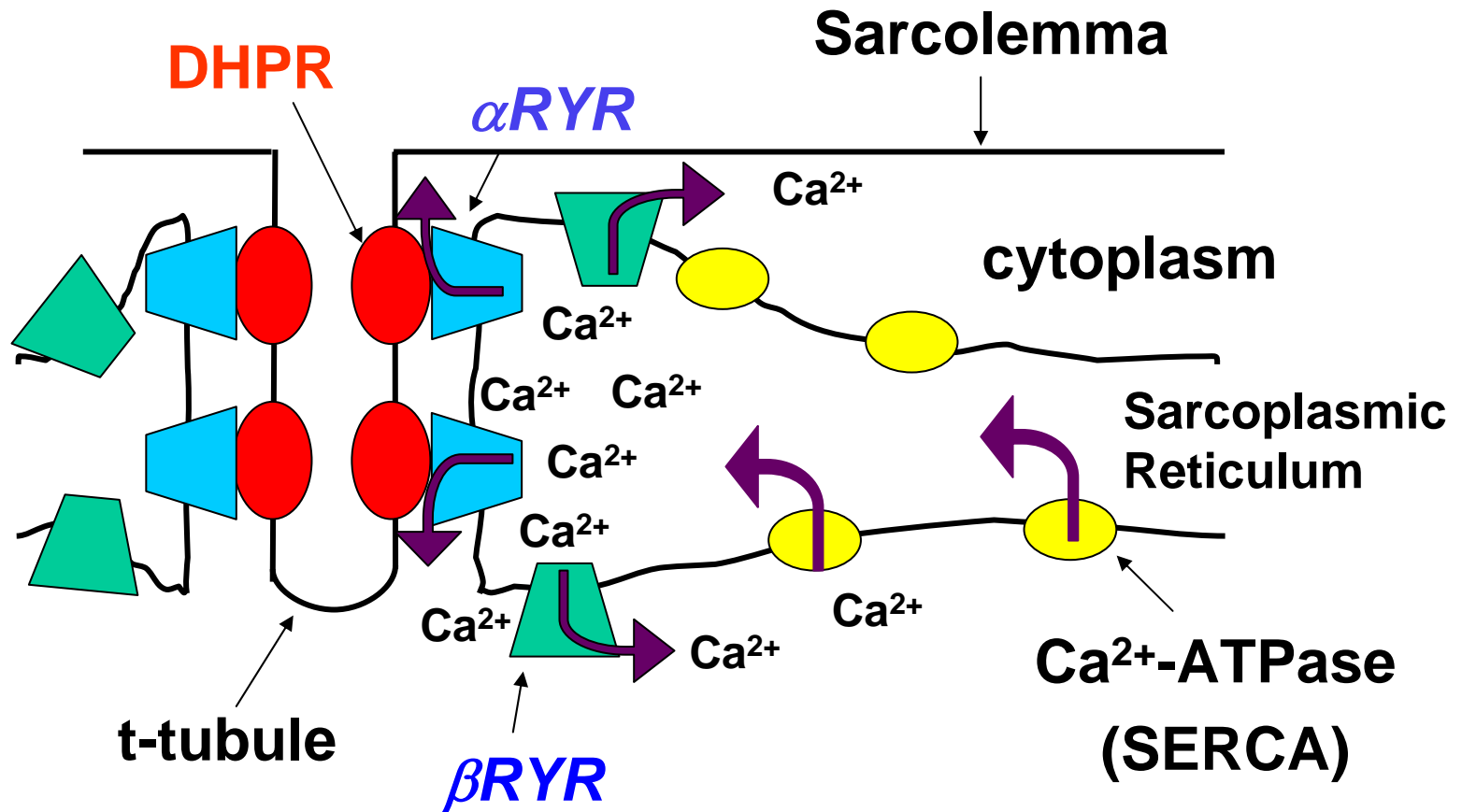


**Muscle hypermetabolism & accelerated glycogenolysis**



**Development of PSE turkey meat**

# *Calcium Regulation in Avian Skeletal Muscle*



# *Factors affecting $Ca^{2+}$ regulation*

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- Primary structure of RYR changed by point mutation or alternative splicing
- Presence of RYR channel activator: halothane, caffeine, thyroid hormone
- RYR and SERCA expression regulated by the thyroid hormone status

# *Thyroid Hormone Regulation*

Normal	Increased basal metabolic rate, O <sub>2</sub> consumption and heat production
Hypothyroidism	Sensitive to cold
Hyperthyroidism	Sensitive to heat

Thyroid hormone levels could influence  
Ca<sup>2+</sup> homeostasis in muscle by:

- affecting RYR and SERCA *activity*
- affecting RYR and SERCA *expression*

# *Objectives*

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- Investigate thyroid hormone levels influenced by heat stress and the influence of thyroid state on expression and functional properties of RYR
- Investigate alternatively spliced  $\alpha$ RYR transcript variants through heat stress treatment
- Evaluate post-heat-stressed turkey meat quality

Turkey resources:

RBC2 (genetic unimproved, random bred line)

Commercial (growth-selected line)

# *Experimental Design*

Turkeys: RBC2 line- M & F

Commercial line- M & F

Heat stress condition: 12 hours of 95°F, 12 hours of 80°F

Heat stress treatments:

Group	Control	1D	3D	5D	Rest
Duration (h)	0	24	72	120	168 stressed 168 rest

Sample collections:

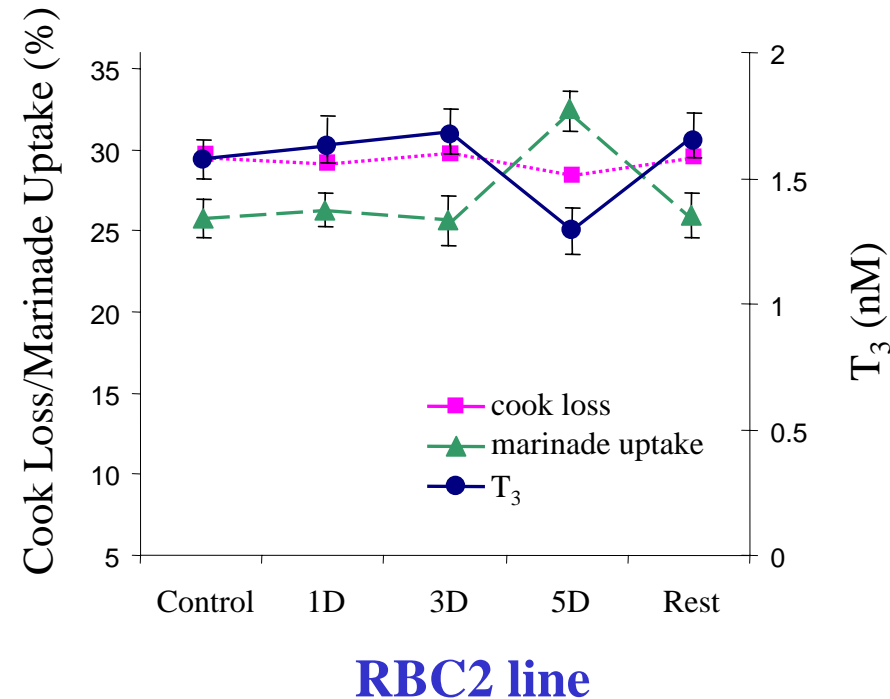
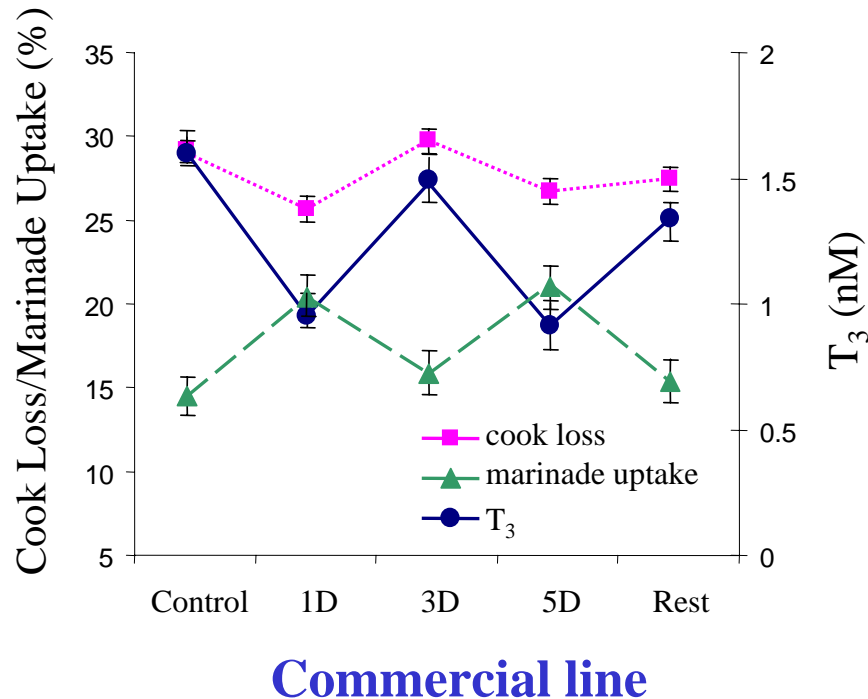
blood (thyroid hormone-T3 & T4)

breast muscle (RNA, RYR purification)

breast muscle (pH<sub>15 min</sub>, color-L\*, drip loss, cook loss,  
marinade uptake)

# *Thyroid hormone and meat quality in response to heat stress*

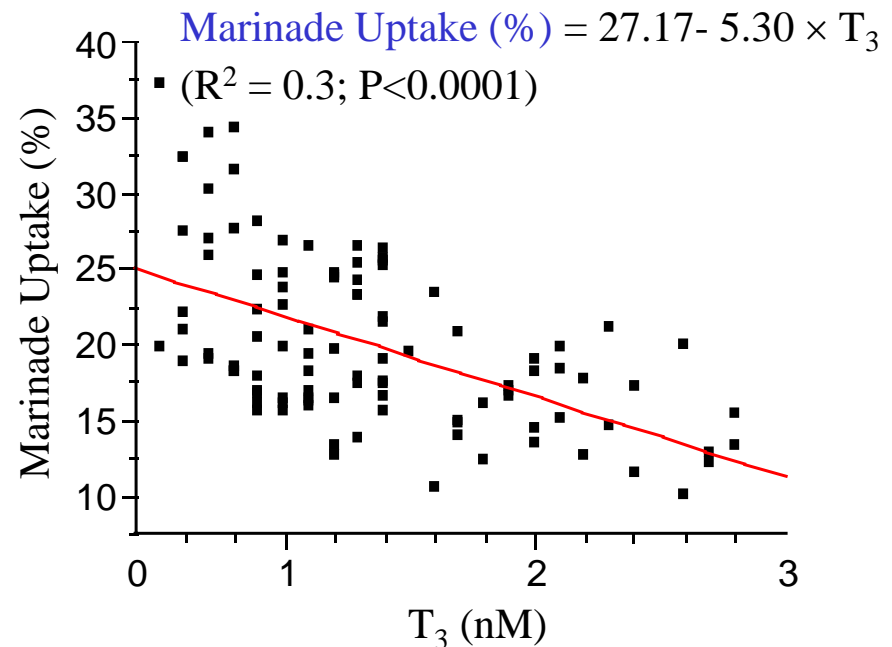
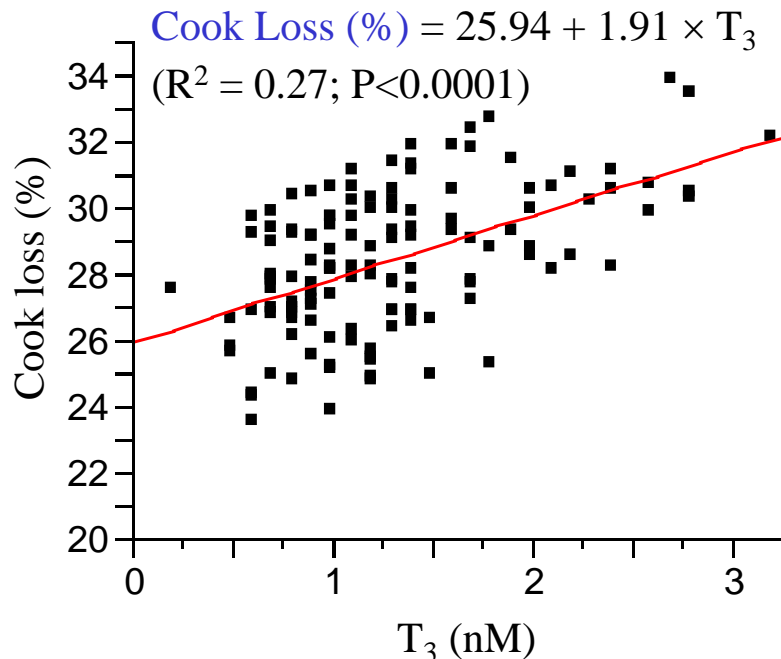
- Thyroid hormone response in heat-stressed birds: commercial birds fluctuated.  
RBC2 birds were stable until stressed for 5D;
- Meat quality in heat-stressed birds: most noticeable in cook loss & marinade uptake



# *Thyroid hormone and meat quality in response to heat stress*

- Variations of cook loss and marinade uptake followed closely to the variations of  $T_3$  in birds of both lines

## Commercial line

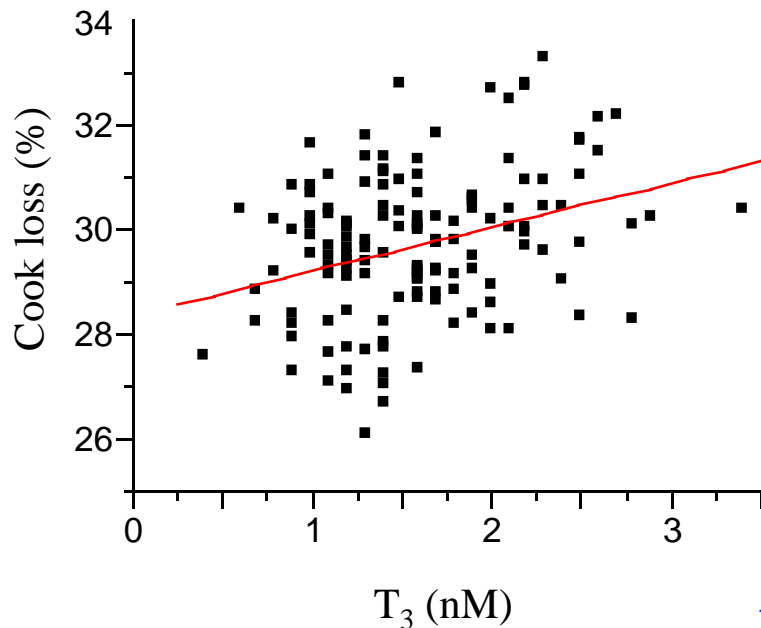


# *Thyroid hormone and meat quality in response to heat stress*

- Variations of cook loss and marinade uptake followed closely to the variations of  $T_3$  in birds of both lines

$$\text{Cook loss (\%)} = 28.36 + 0.84 \times T_3$$

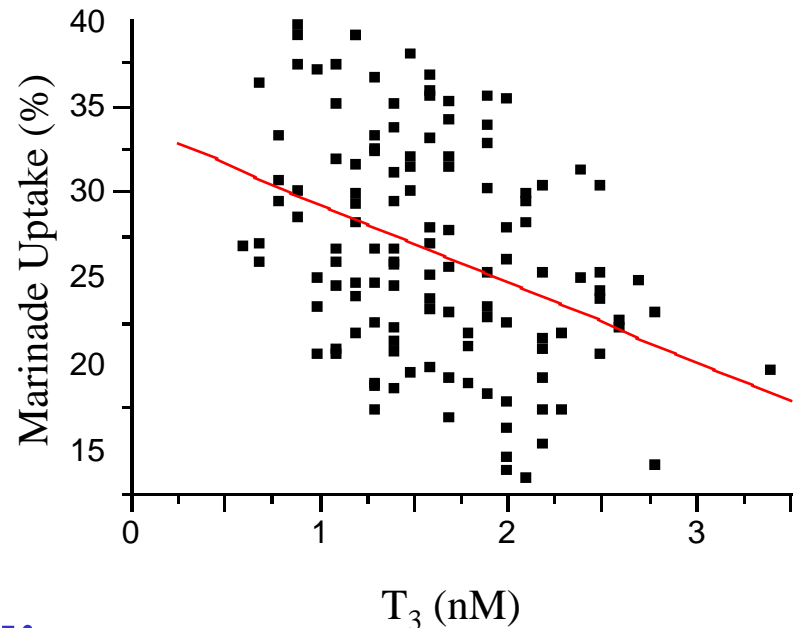
( $R^2=0.11$ ;  $P<0.0001$ )



**RBC2 line**

$$\text{Marinade Uptake (\%)} = 33.98 - 4.58 \times T_3$$

( $R^2=0.14$ ;  $P<0.0001$ )



# *Conclusions*

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- Growth selection did not have a negative impact on meat quality, but meat quality from commercial birds was less consistent when birds were heat-stressed
- Birds with stable thyroid hormone response to heat are likely to produce consistent fresh turkey meat and further processed turkey products.

# *Questions*

